

In re Patent Application of:  
**BOUCHE ET AL.**  
Serial No. 10/729,827  
Filing Date: December 5, 2003

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REMARKS

Applicants would like to thank the Examiner for the thorough examination of the present application. Applicants would also like to thank the Examiner for correctly indicating as allowable the subject matter of dependent Claims 24 and 25.

Claims 26-50 have been cancelled based upon the restriction requirement. Applicants reserve the right for file a divisional application directed to the subject matter thereof. The arguments supporting patentability of the claims are provided below.

I. The Claims Are Patentable

The Examiner rejected independent Claim 16 over each of the following patents/published patent applications: 1) U.S. Patent No. 4,763,828 to Fukaya et al., 2) U.S. Published Patent Application No. 2005/0168306 to Cohn et al., 3) U.S. Patent No. 6,507,103 to Yamaguchi et al., and 4) U.S. Published Patent Application No. 2003/0197050 to Graham et al.

The present invention, as recited in independent Claim 16, is directed to a method for attaching a first element to a second element, with the first element having a surface portion covered with a layer of silicon and the second element having a surface portion covered with a layer of nickel. The method comprises applying pressure so that the surface portions of the first and second elements are in contact with one another, with a roughness between the surface portions being less than about 1  $\mu\text{m}$ , and heating the first and second elements at a temperature greater than 250°C.

As noted in the background section of the application, the adhesion of the two elements within a

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microsystem is typically accomplished using a polymer material for bonding. However, this approach poses a problem. Since the polymer is insulating, it does not allow an electrical contact to be made. In addition, in the case of encapsulating components, the use of a polymer for bonding does not allow a hermetically sealed system to be obtained. The method in accordance with the present invention advantageously provides a roughness of less than about 1  $\mu$ m between the silicon and nickel layers to be bonded - and this allows a strong, reliable and vacuum-tight bond to be obtained.

1) The Fukaya et al. patent discloses in examples 5 and 6 a method for attaching a smooth element coated with Si to a smooth element coated with Ni (FIG. 1D and column 2, lines 15-60), and heating to a temperature greater than 250°C for at least 5 minutes to an hour. In FIG. 1D, the silicon Si is part of the insert material indicated by reference 3, and the nickel Ni is part of the brazing material indicated by reference 4. In example 5, the insert material 3 is 3 mm thick, whereas the brazing material 4 is 5 mm thick. Similarly, in example 6, the insert material 3 is 3 mm thick, whereas the brazing material 4 is 5 mm thick.

2) The Cohn et al. published patent application discloses a method for attaching a smooth element coated with Si to a smooth element coated with Ni, and heating to a temperature of about 300°C for about 10 minutes (paragraphs 85 and 92 and claim 18).

In paragraph 85, reference is made to the two rings that bond the first and second wafers together in FIGS. 11A-11C. The two rings are the seal ring 206 and the seal-landing ring 224. These two rings are best illustrated in FIGS. 2A

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and 2B. In paragraph 64, the seal-landing ring 224 is "preferably about 1.5 microns thick in its vertical dimension."

3) The Yamaguchi et al. patent discloses a method for attaching a smooth element coated with Si 21 up to 0.2 microns thick (column 3, line 56) to a smooth element coated with Ni, and heated to a temperature of 350 to 500°C for several minutes to several hours (column 3, line 57 - column 4, line 34).

As shown in FIG. 3, and as disclosed in column 3, line 66 to column 4, line 1, "thickness of the constituent layer of the bonding layer 4 is set to several tens of micrometers for the Ti layer and several hundreds of micrometers for the Ni layer." As disclosed in column 3, line 53, the thickness of the Si 21 is 5500 Angstroms (i.e., 5.5 microns).

4) The Graham et al. published patent application discloses a method for attaching a smooth element coated with Si up to 1 micron thick to a smooth element coated with Ni up to 50 nm (paragraphs 18-21). Multiple layers may be used (paragraphs 27-28), and heating to a temperature greater than 250°C (1100°F or 593°C) for 1 minute (paragraphs 37-39).

In particular, Graham et al. discloses that the Si coating has a thickness within a range of about 3 to 20 microns, and more preferably, within a range of about 5 to 10 microns. However, Graham et al. further discloses in paragraph 18 that the Si may have a thinner thickness "of about 1 micron." In addition, the "Si layer of about 1 micron should be in contact with the Ni braze promoter." The Ni braze promoter has a thickness of 20-50 nm.

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Neither of the prior art references cited by the Examiner disclose any of the elements with a roughness of less than about 1  $\mu\text{m}$  between the silicon and nickel layers to be bonded, as recited in independent Claim 16. As noted above, this advantageously allows a strong, reliable and vacuum-tight bond to be obtained.

Accordingly, it is submitted that independent Claim 16 is patentable over each of the following: the Cohn et al. published patent application; the Cohn et al. published patent application; the Yamaguchi et al. patent; and the Graham et al. published patent application. In view of the patentability of independent Claim 16, it is submitted that the dependent claims, which recite yet further distinguishing features of the invention, are also patentable. These dependent claims require no further discussion herein.


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CONCLUSION

In view of the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,

  
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CERTIFICATE OF FACSIMILE TRANSMISSION

I HEREBY CERTIFY that the foregoing correspondence has been forwarded via facsimile number 571-273-8300 to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 this 30<sup>th</sup> day of May, 2006.

